On Specifying Optical Power and Extinction Ratio

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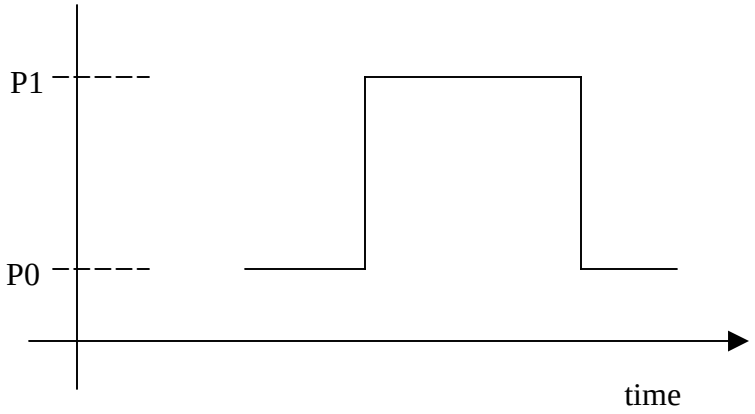
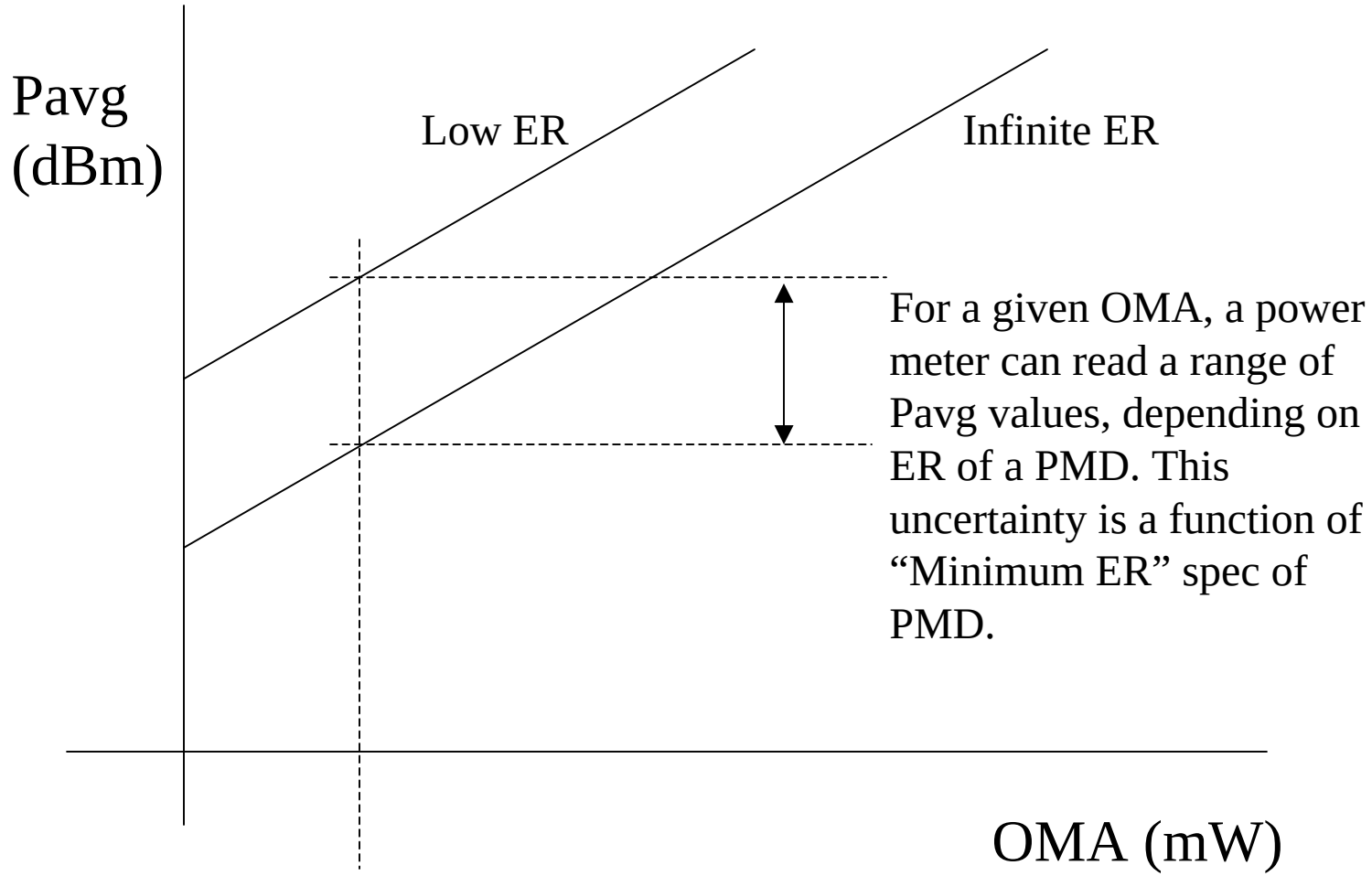
Background



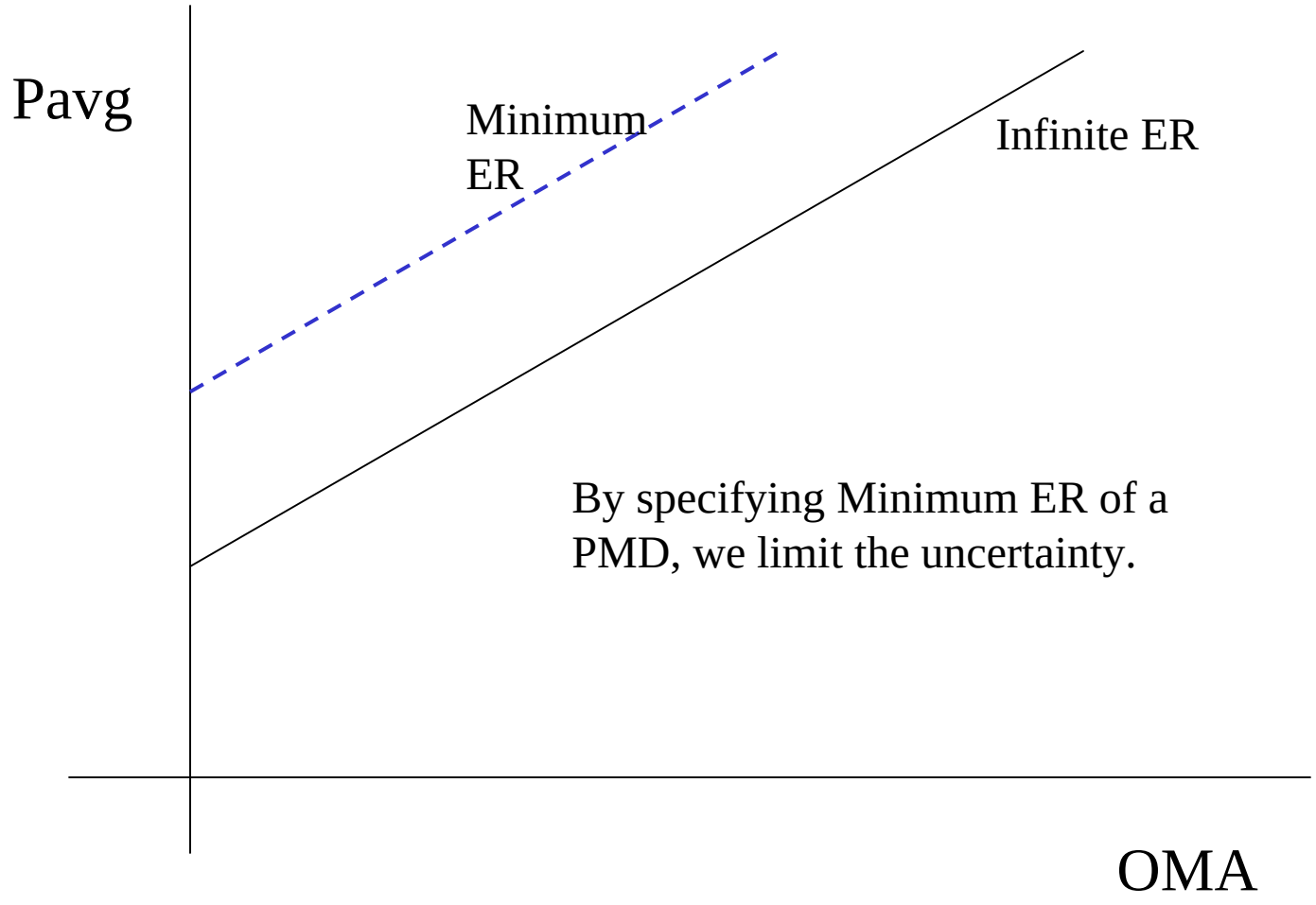
- Average Power Pavg = (P0 + P1)/2
- Extinction Ratio ER = P1/P0
- Optical Modulation Amplitude OMA = P1 – P0
- Pavg = OMA*0.5*((ER+1)/(ER-1))
- ER = ((2*Pavg) + OMA)/ ((2*Pavg) - OMA)
- OMA = 2*Pavg*(ER-1)/(ER+1)

The unconstrained picture

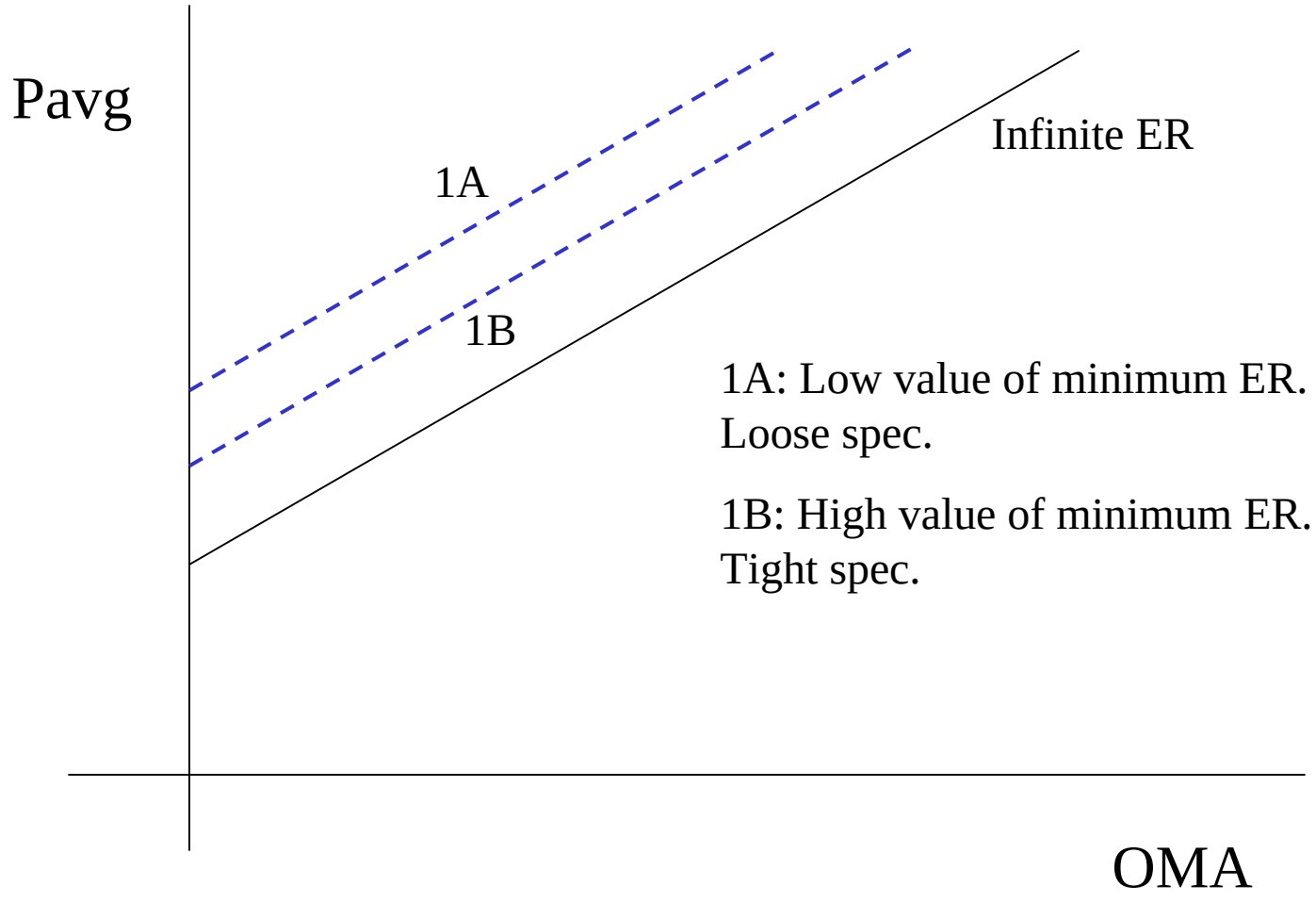


For a given OMA, a power meter can read a range of Pavg values, depending on ER of a PMD. This uncertainty is a function of "Minimum ER" spec of PMD.

Constraint 1: Minimum ER



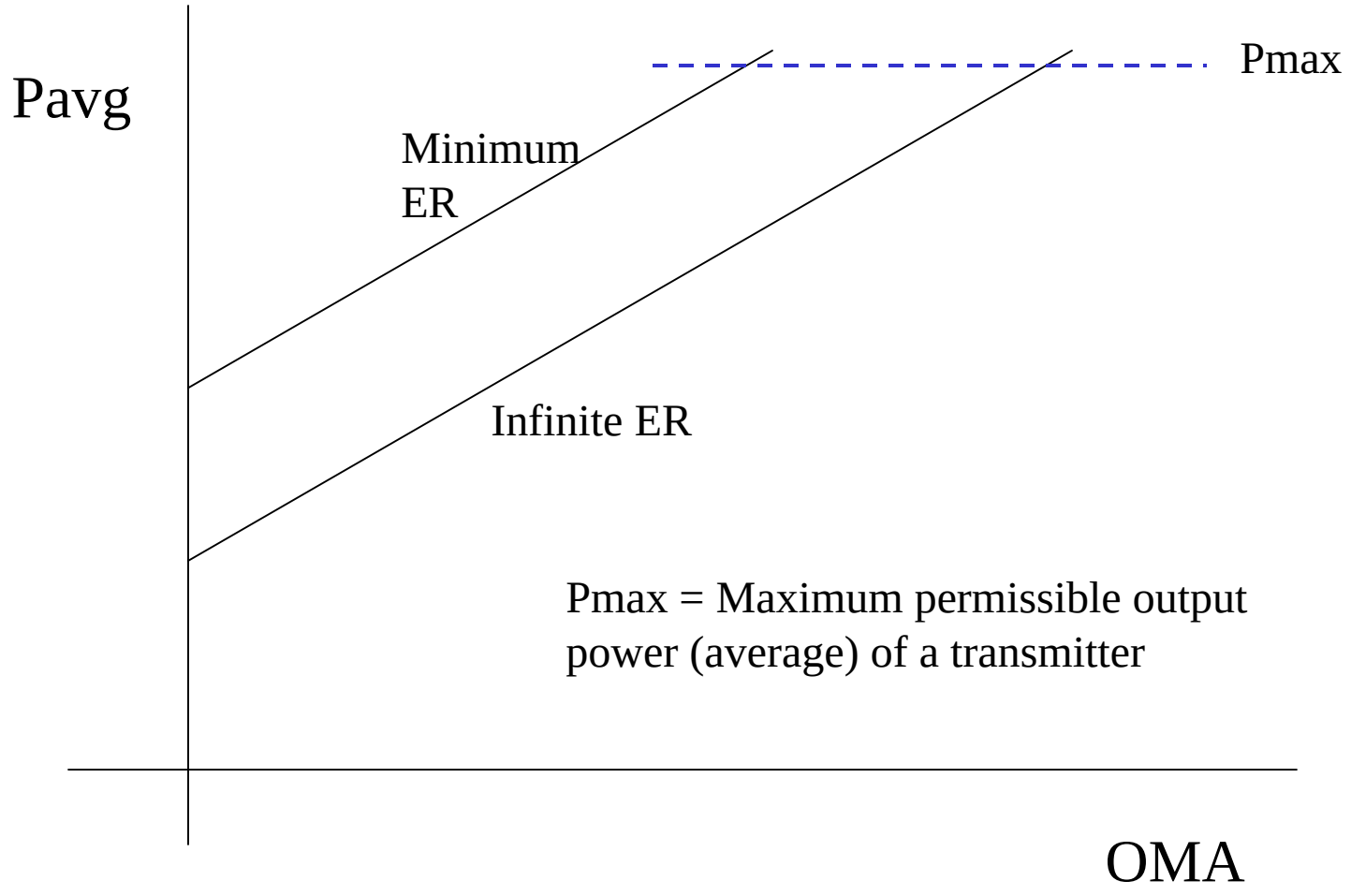
Constraint 1: Two flavors



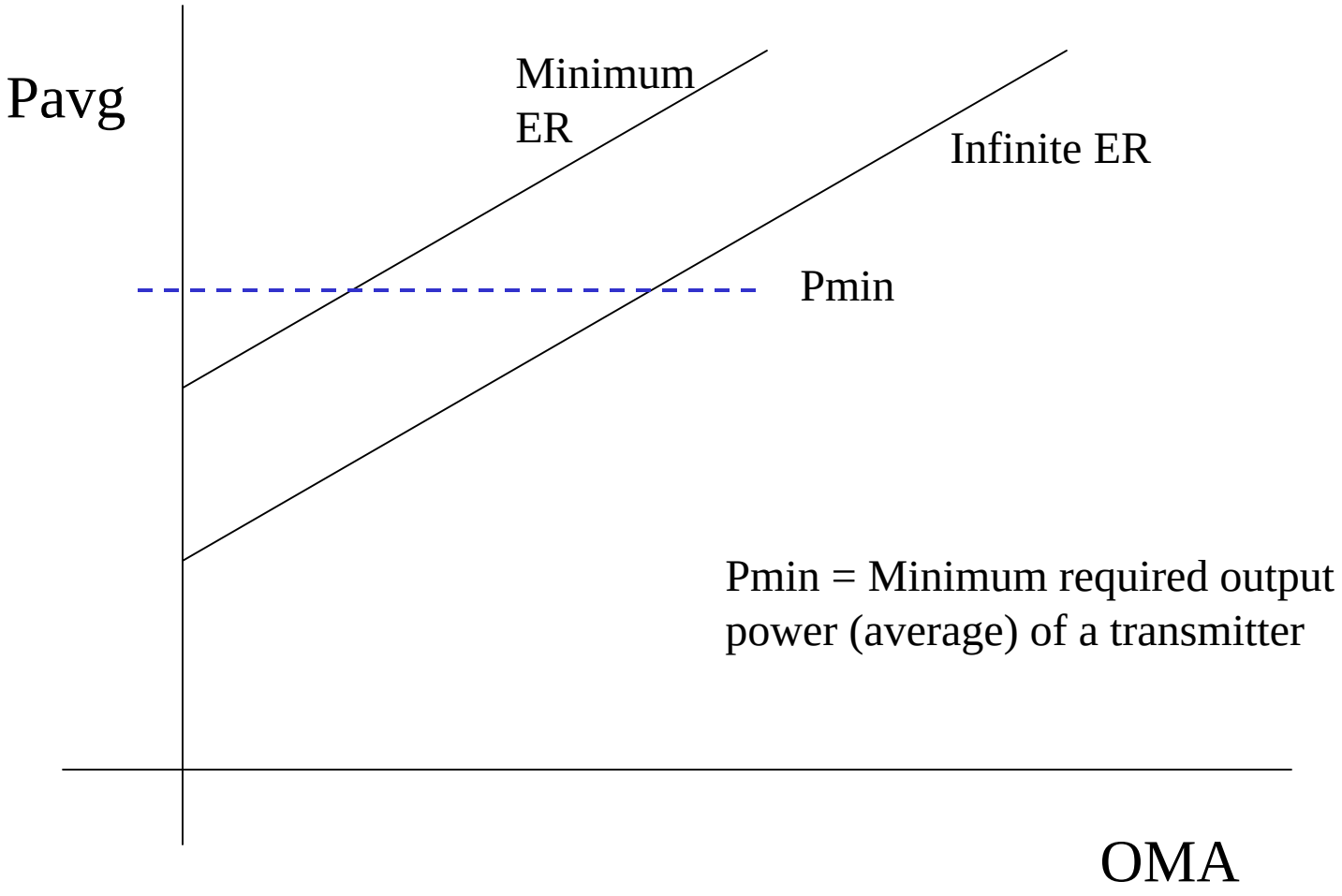
1A: Low value of minimum ER. Loose spec.

1B: High value of minimum ER. Tight spec.

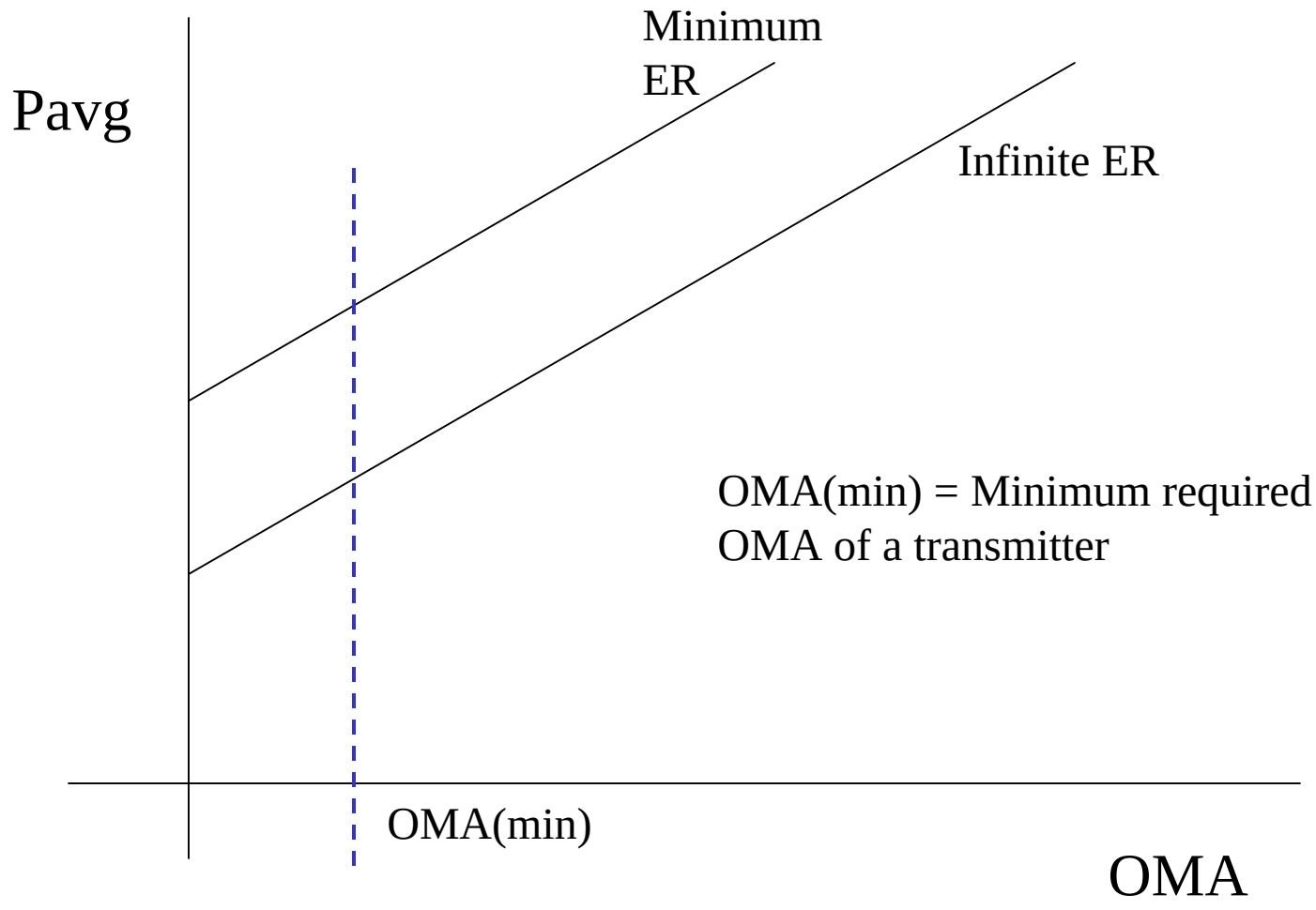
Constraint 2: Pmax



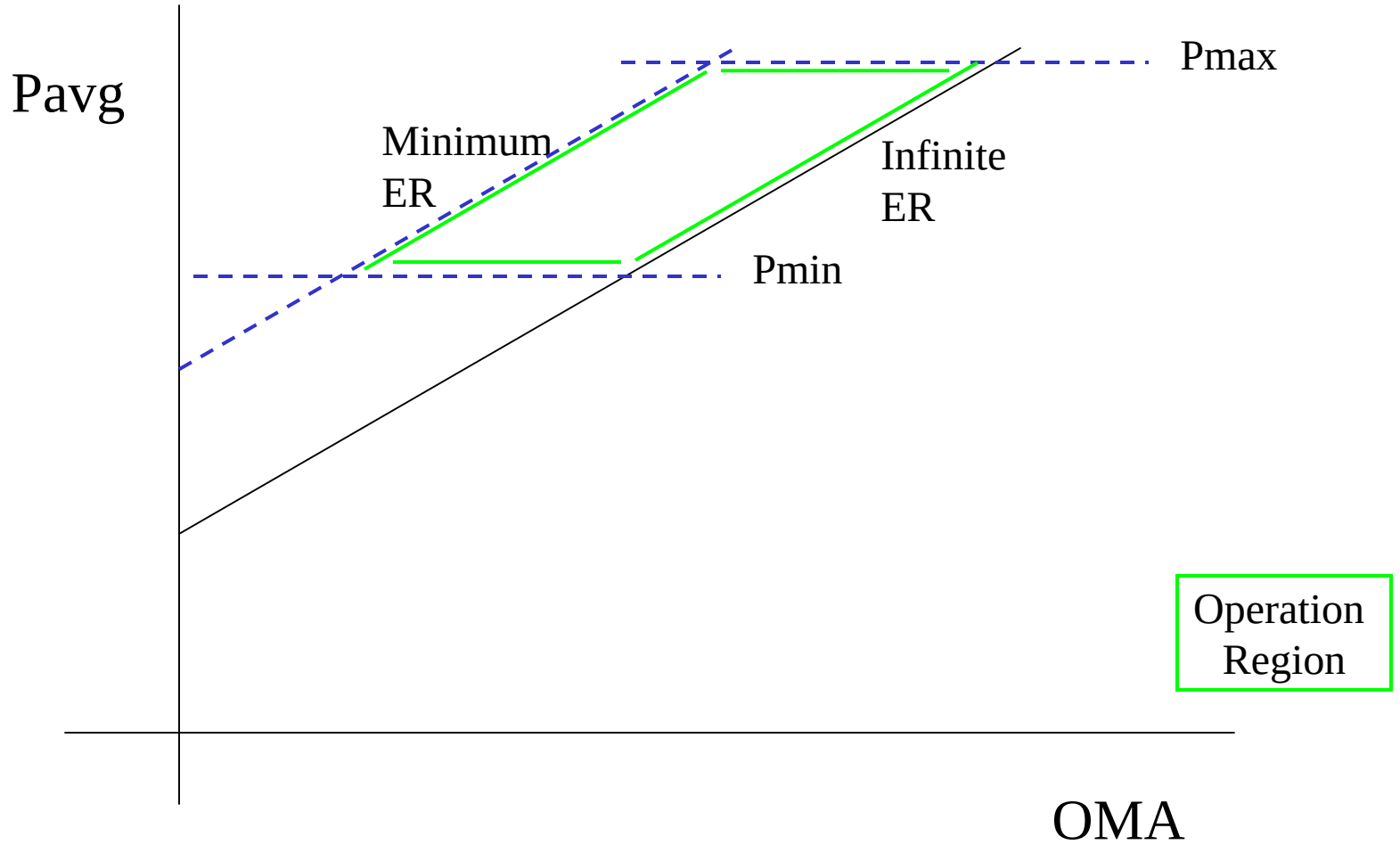
Constraint 3A: Pmin



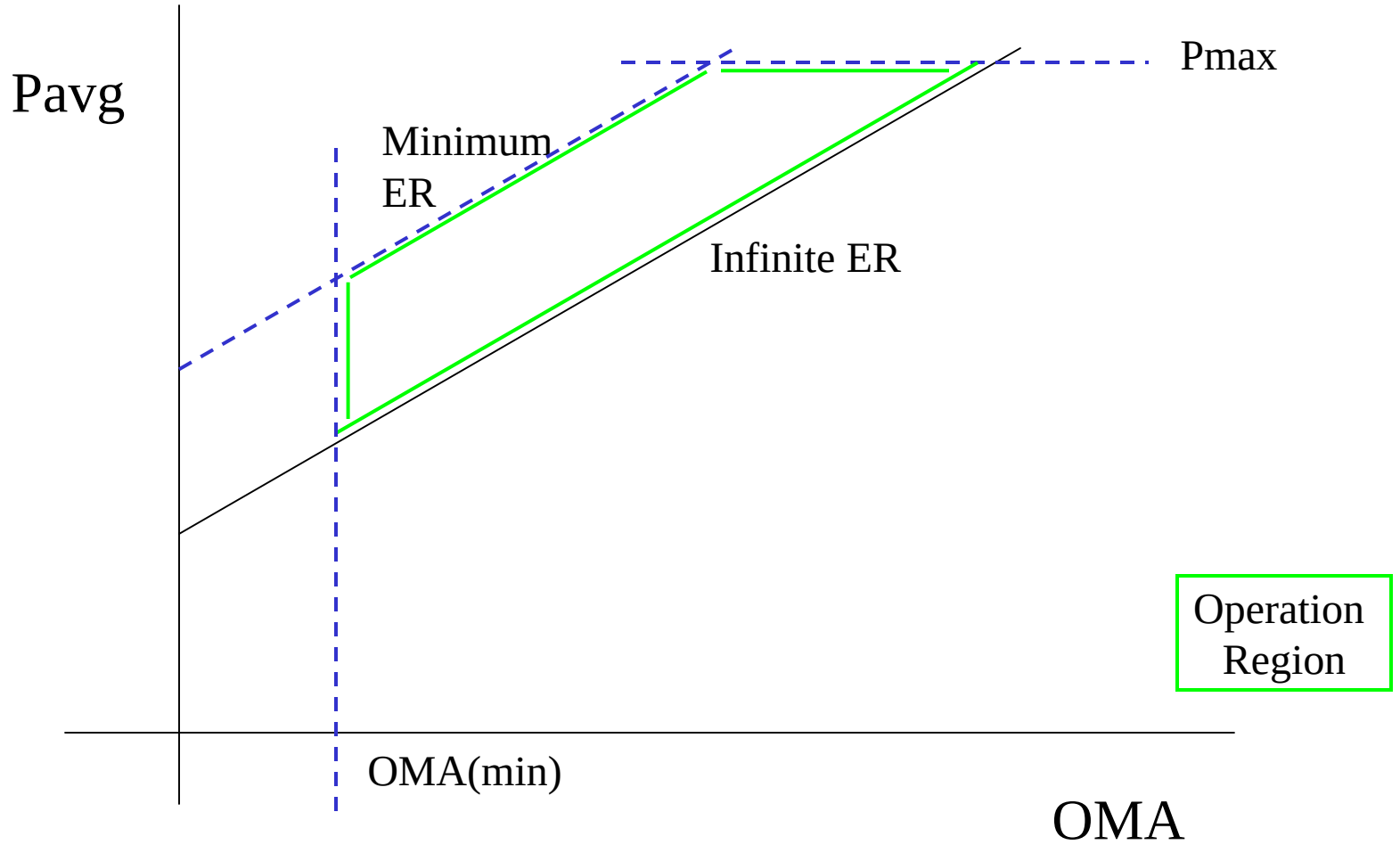
Constraint 3B: OMA(min)



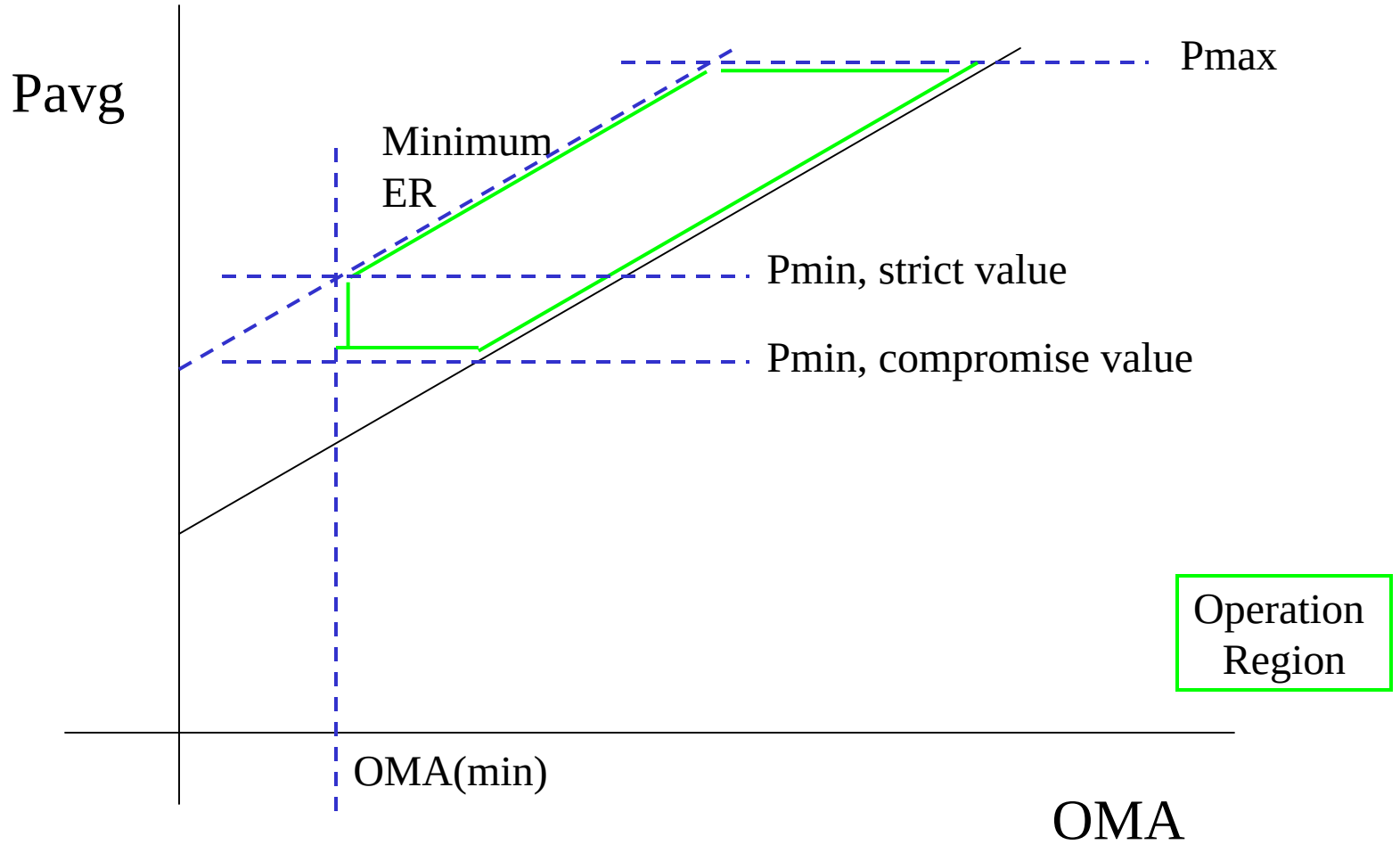
Constrained picture A: 1 + 2 + 3A



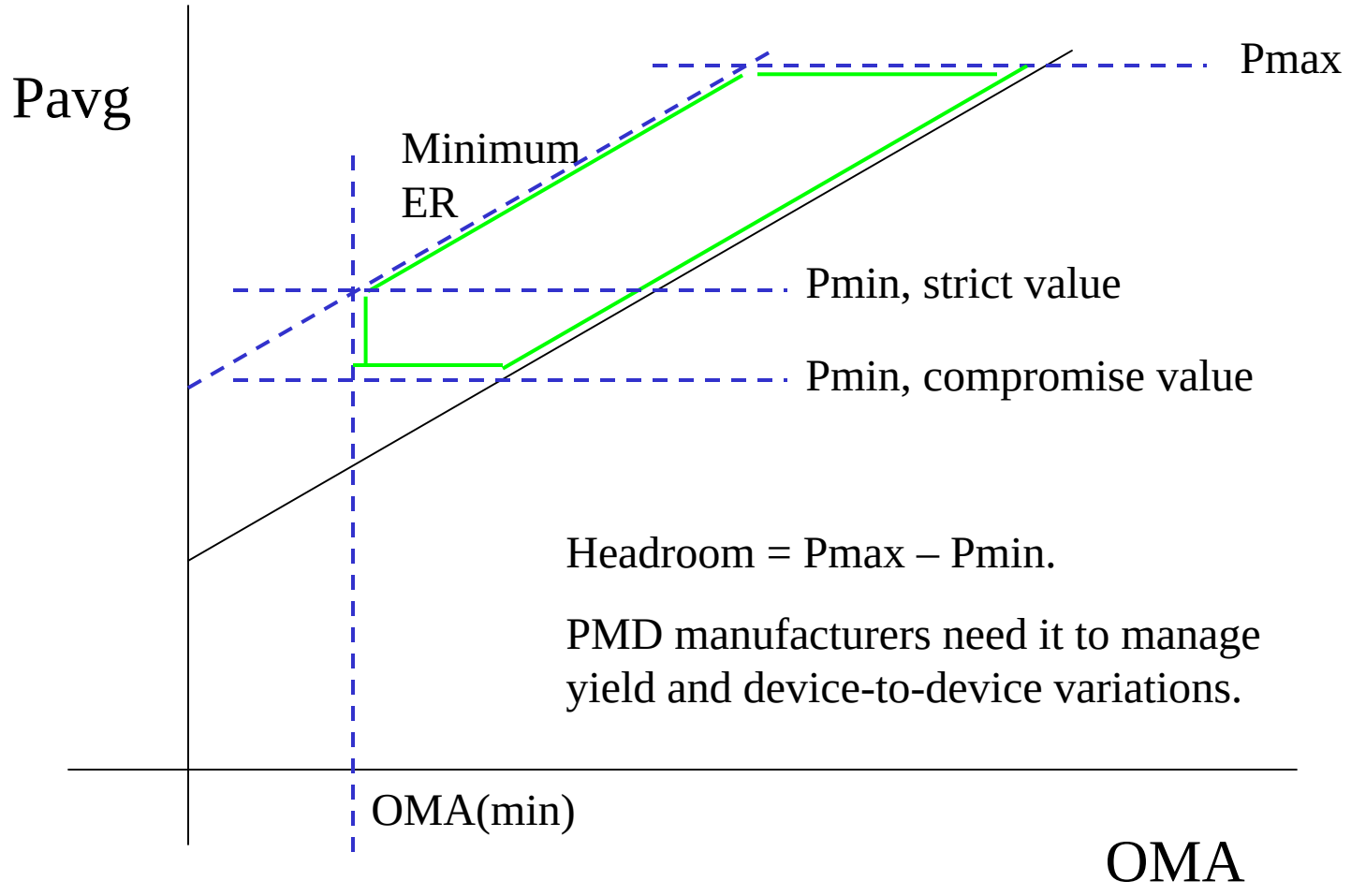
Constrained picture B: 1 + 2 + 3B



Compromise: 1 + 2 + 3A + 3B



Headroom


Pavg
Pmax
Minimum
ER
Pmin, strict value
Pmin, compromise value
Headroom = Pmax – Pmin.
PMD manufacturers need it to manage yield and device-to-device variations.
OMA(min)
OMA

Decisions Needed

- 1A or 1B? How loose or tight do we want the Minimum ER to be?
- 3A or 3B? Do we want the low power end to be specified as average power or OMA?
- Are these Exclusive-OR choices, or is a “redundant” compromise a better solution?
- How much headroom do we need?
- Different answers for different PMDs?

Options

Design option	Arguments for	Arguments against
1A + 2 + 3A, low ER, Pmin	High yield, power meter friendly.	To a receiver, only AC swing matters. Unnecessarily restrictive.
1A + 2 + 3B, low ER, OMAmin	High manufacturing yields.	Interferometric Noise penalty high.
1B + 2 + 3A, high ER, Pmin	Power meter friendly. Compatible with ITU PON spec.	Low manufacturing yields.
1B + 2 + 3B, high ER, OMAmin	Power meter friendly.	But still needs mapping from OMA to Pavg for power meters. So what's the benefit?
1A + 2 + 3A + 3B, low ER, both Pmin and OMAmin	Good compromise, high yield. Will help 100M transmitters with margin against BLW degradation. The power requirements for 100M are low enough to permit this flexibility.	Don't make the ER too low; it is not necessary. Large experience base has enabled vendors to achieve a modestly high ER easily.
1B + 2 + 3A + 3B, high ER, both Pmin and OMAmin	Good compromise. Maybe PON friendly, according to some implementers. If ER is not too high, ideal for 1000BASE-EX and –BX.	Don't make ER too high. OLT receivers can handle slightly lower ER.

Concluding Remarks

- In the “Options” table, rows 5 and 6 seem more attractive than others. Further, the difference between the two depends on the subjective definitions of “high” and “low” ER.
- Suggest next steps:
  - Adopt 3A + 3B as the method of specifying low end of power.
  - Select Minimum ER and headroom for each PMD case by case, taking into account its unique cost structure and tolerances.